



**University of  
Zurich**<sup>UZH</sup>

**Zurich Open Repository and  
Archive**

University of Zurich  
University Library  
Strickhofstrasse 39  
CH-8057 Zurich  
[www.zora.uzh.ch](http://www.zora.uzh.ch)

---

Year: 2017

---

## **A new, exceptionally preserved juvenile specimen of *Eusaurosphargis dalsassoi* (Diapsida) and implications for Mesozoic marine diapsid phylogeny**

Scheyer, Torsten M ; Neenan, James M ; Bodogan, Timea ; Furrer, Heinz ; Obrist, Christian ;  
Plamondon, Mathieu

**Abstract:** Recently it was suggested that the phylogenetic clustering of Mesozoic marine reptile lineages, such as thalattosaurs, the very successful fish-shaped ichthyosaurs and sauropterygians (including plesiosaurs), among others, in a so-called ‘superclade’ is an artefact linked to convergent evolution of morphological characters associated with a shared marine lifestyle. Accordingly, partial ‘un-scoring’ of the problematic phylogenetic characters was proposed. Here we report a new, exceptionally preserved and mostly articulated juvenile skeleton of the diapsid reptile, *Eusaurosphargis dalsassoi*, a species previously recovered within the marine reptile ‘superclade’, for which we now provide a revised diagnosis. Using micro-computed tomography, we show that besides having a deep skull with a short and broad rostrum, the most outstanding feature of the new specimen is extensive, complex body armour, mostly preserved in situ, along its vertebrae, ribs, and forelimbs, as well as a row of flat, keeled ventrolateral osteoderms associated with the gastralia. As a whole, the anatomical features support an essentially terrestrial lifestyle of the animal. A review of the proposed partial character ‘un-scoring’ using three published data matrices indicate that this approach is flawed and should be avoided, and that within the marine reptile ‘superclade’ *E. dalsassoi* potentially is the sister taxon of Sauropterygia.

DOI: <https://doi.org/10.1038/s41598-017-04514-x>

Posted at the Zurich Open Repository and Archive, University of Zurich

ZORA URL: <https://doi.org/10.5167/uzh-138202>

Journal Article

Accepted Version

Originally published at:

Scheyer, Torsten M; Neenan, James M; Bodogan, Timea; Furrer, Heinz; Obrist, Christian; Plamondon, Mathieu (2017). A new, exceptionally preserved juvenile specimen of *Eusaurosphargis dalsassoi* (Diapsida) and implications for Mesozoic marine diapsid phylogeny. *Scientific Reports*, 7(1):4406.

DOI: <https://doi.org/10.1038/s41598-017-04514-x>

## **Supplementary Information**

### **A new, exceptionally preserved juvenile specimen of *Eusaurosphargis dalsassoi* (Diapsida) and implications for Mesozoic marine diapsid phylogeny**

Torsten M. Scheyer<sup>1,\*</sup>, James. M. Neenan<sup>2</sup>, Timea Bodogan<sup>1</sup>, Heinz Furrer<sup>1</sup>, Christian Obrist<sup>3</sup>, Mathieu Plamondon<sup>4</sup>

<sup>1</sup>Paläontologisches Institut und Museum der Universität Zürich, Karl Schmid-Strasse 4, CH-8006 Zurich, Switzerland

<sup>2</sup>Oxford University Museum of Natural History, Parks Road, Oxford, OX1 3PW, UK

<sup>3</sup>Erliackerweg 8, 4462 Rickenbach, BL, Switzerland

<sup>4</sup>Empa, Swiss Federal Laboratories for Materials Science and Technology, Center for X-ray Analytics, Überlandstrasse 129, CH-8600 Dübendorf, Switzerland

Correspondence and requests for materials should be addressed to T.M.S. (tscheyer@pim.uzh.ch).

## **Content**

### **Supplementary Figures**

Supplementary 3D Figure S1 (3D content needs to be enabled in the PDF)

Supplementary 3D Figure S2 (3D content needs to be enabled in the PDF)

Supplementary Figures S3-S12 (no 3D content needed in the PDF)

### **Supplementary Note**

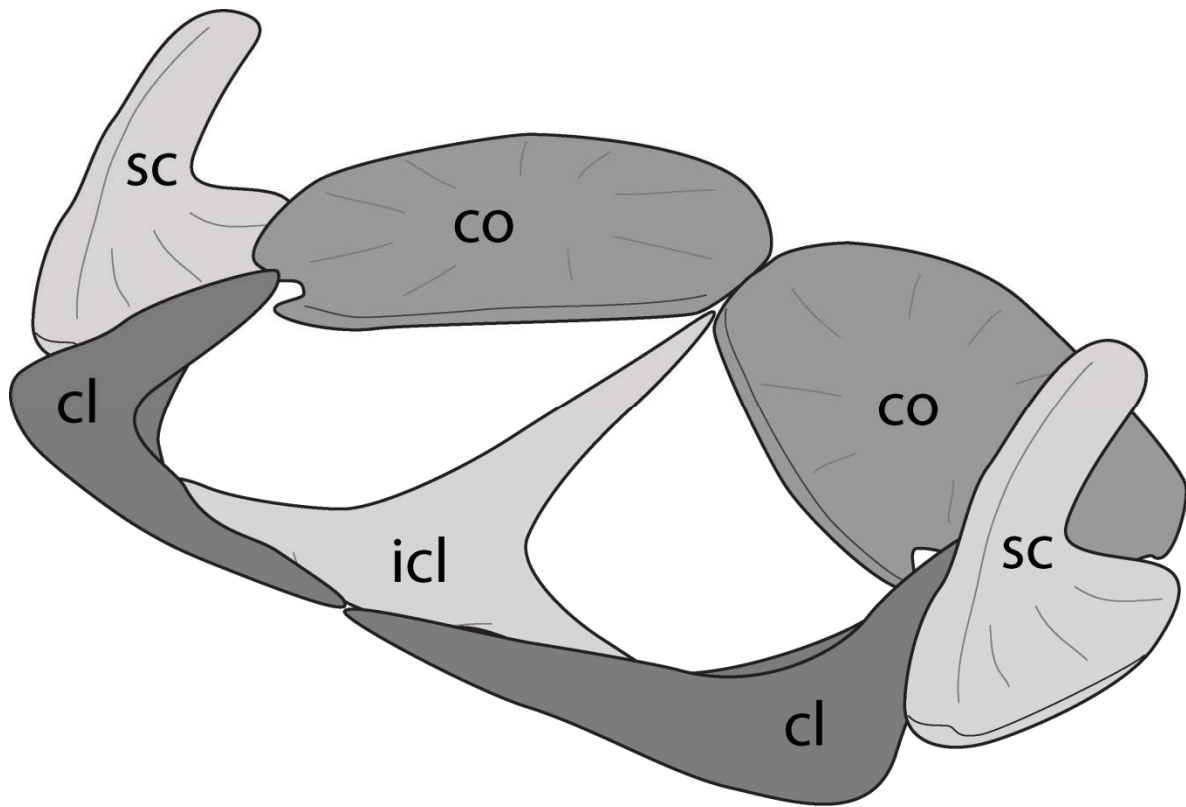
Updated and new scorings for *Eusaurosphargis dalsassoi*

### **Supplementary References**



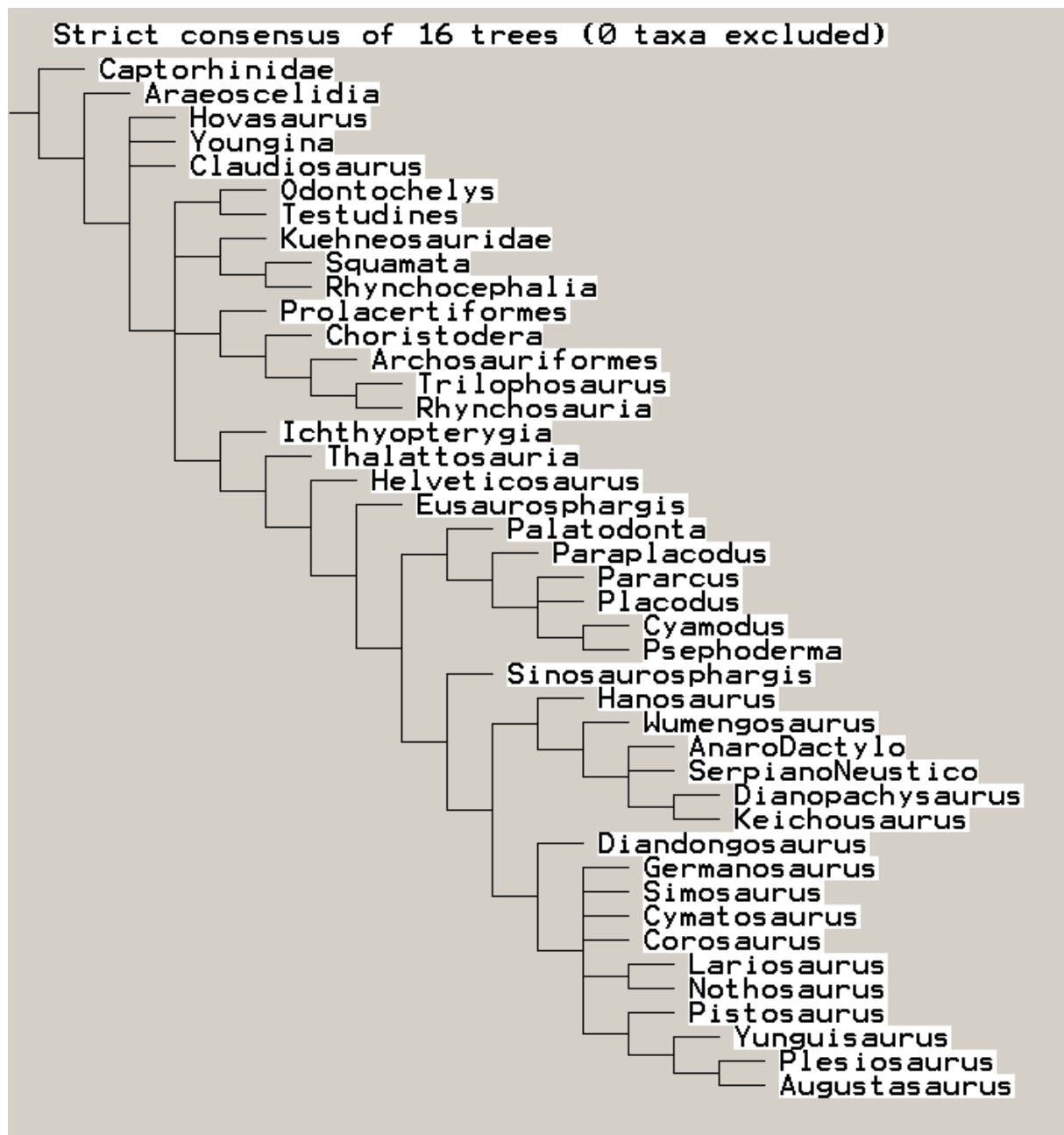


**Supplementary Figure S3. Interpretative reconstruction of the pelvic girdle of *Eusaurosphargis dalsassoi* based on PIMUZ A/III 4380.**



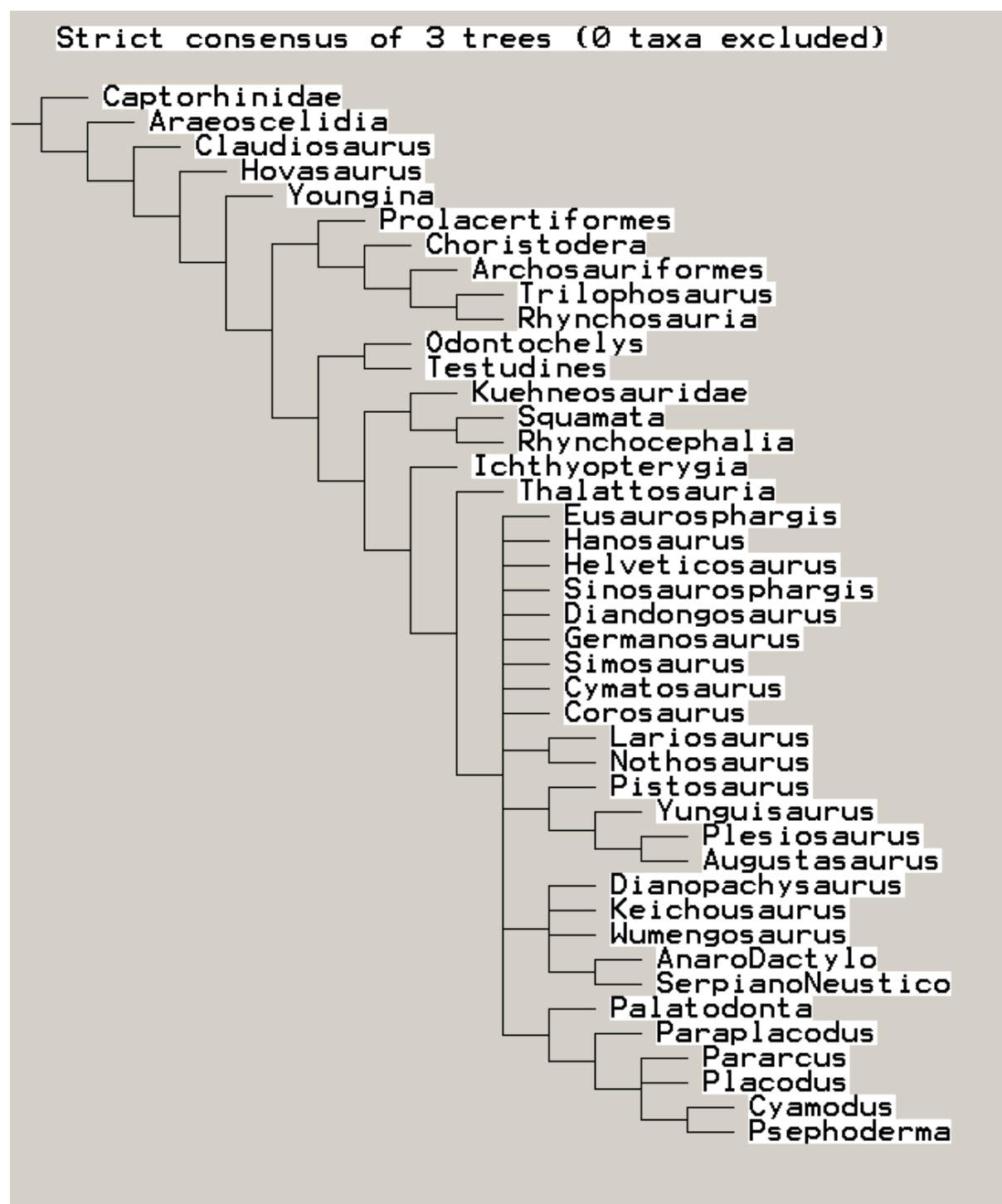
Abbreviations used in the figure are clavicle (cl), coracoid (co), interclavicle (icl), and scapula (sc). Not to scale.

Supplementary Figure S4. Analysis 1 run in TNT.



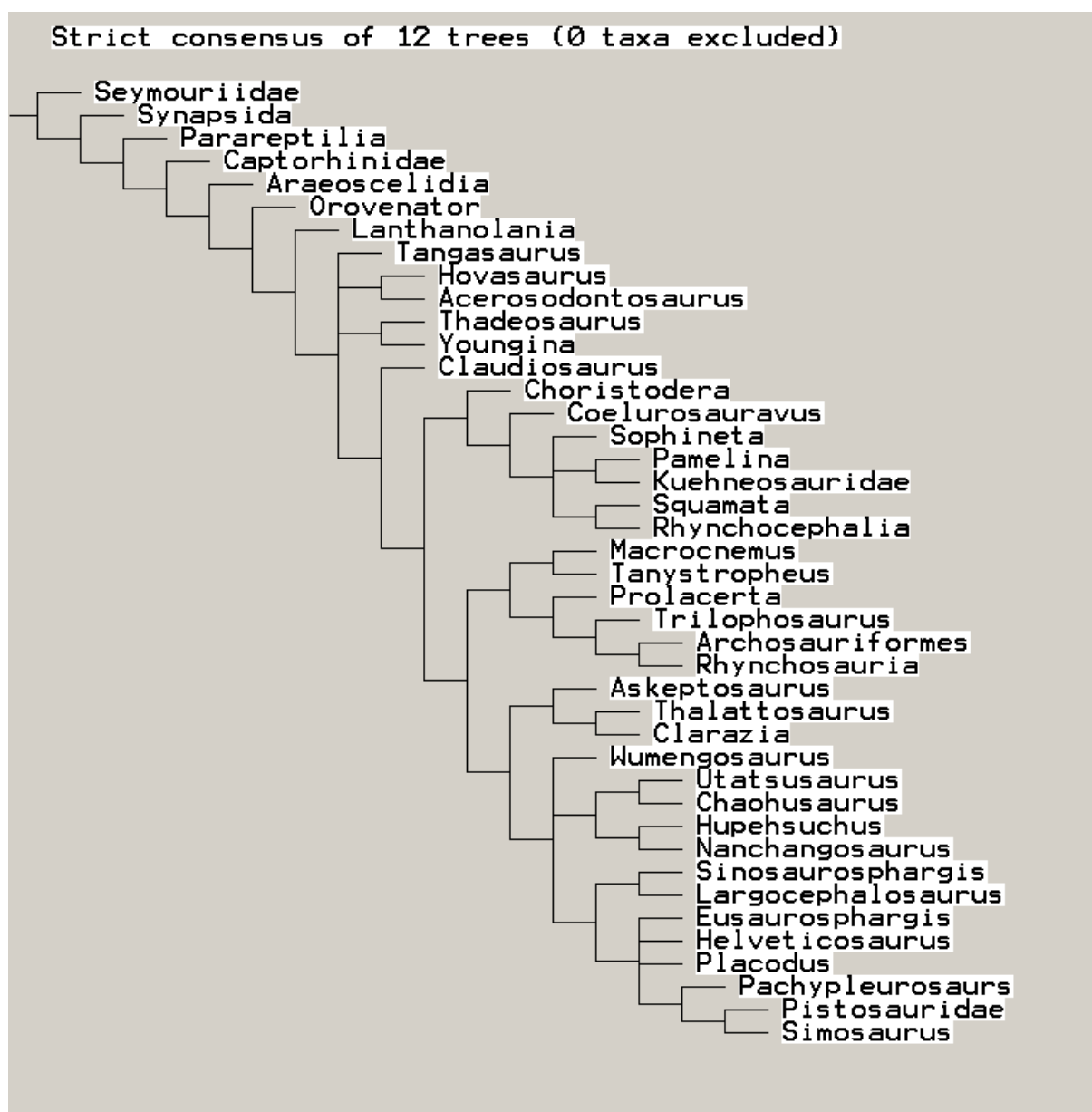
Analysis using the first matrix<sup>1</sup> with all taxa and characters included.

Supplementary Figure S5. Analysis 2 run in TNT.



Analysis using the first matrix<sup>1</sup> with all taxa but characters 90, 113, 114, 120, 126, 127, and 131 excluded.

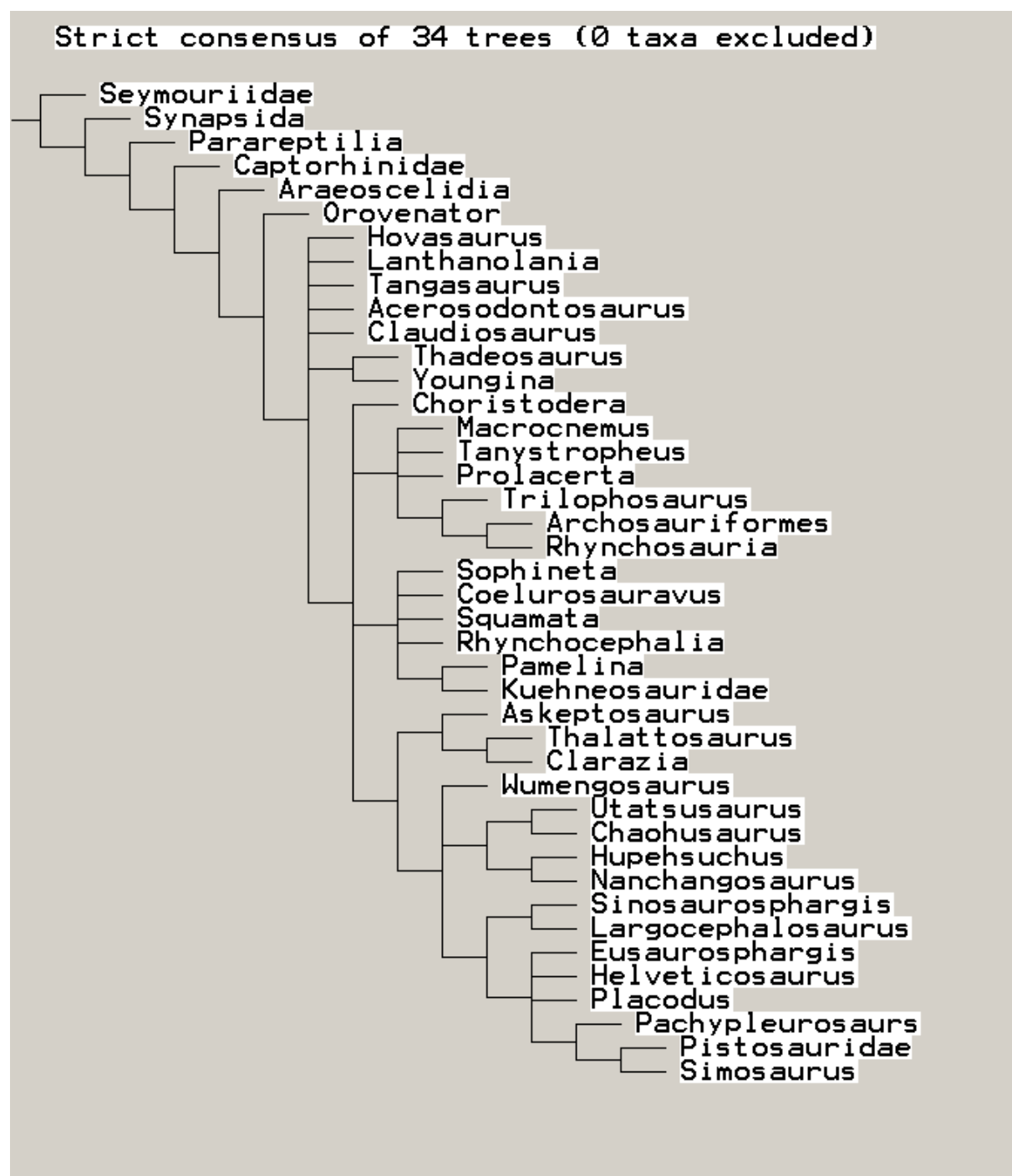
Supplementary Figure S6. Analysis 3 run in TNT.



Analysis using the second matrix<sup>2</sup> with with *Eusaurosphargis dalsassoi* added and all characters included.

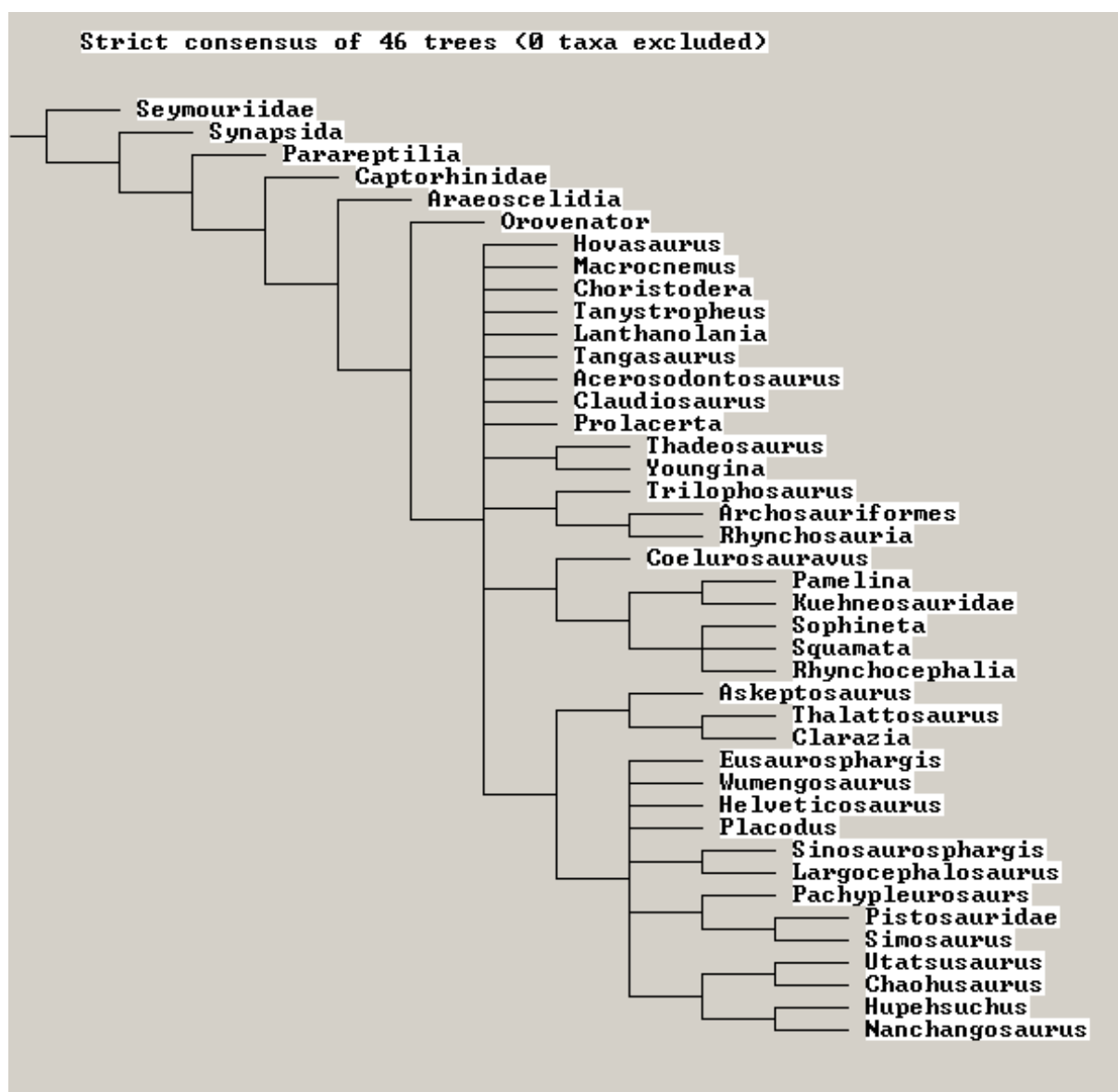


Supplementary Figure S7. Analysis 4 run in TNT.



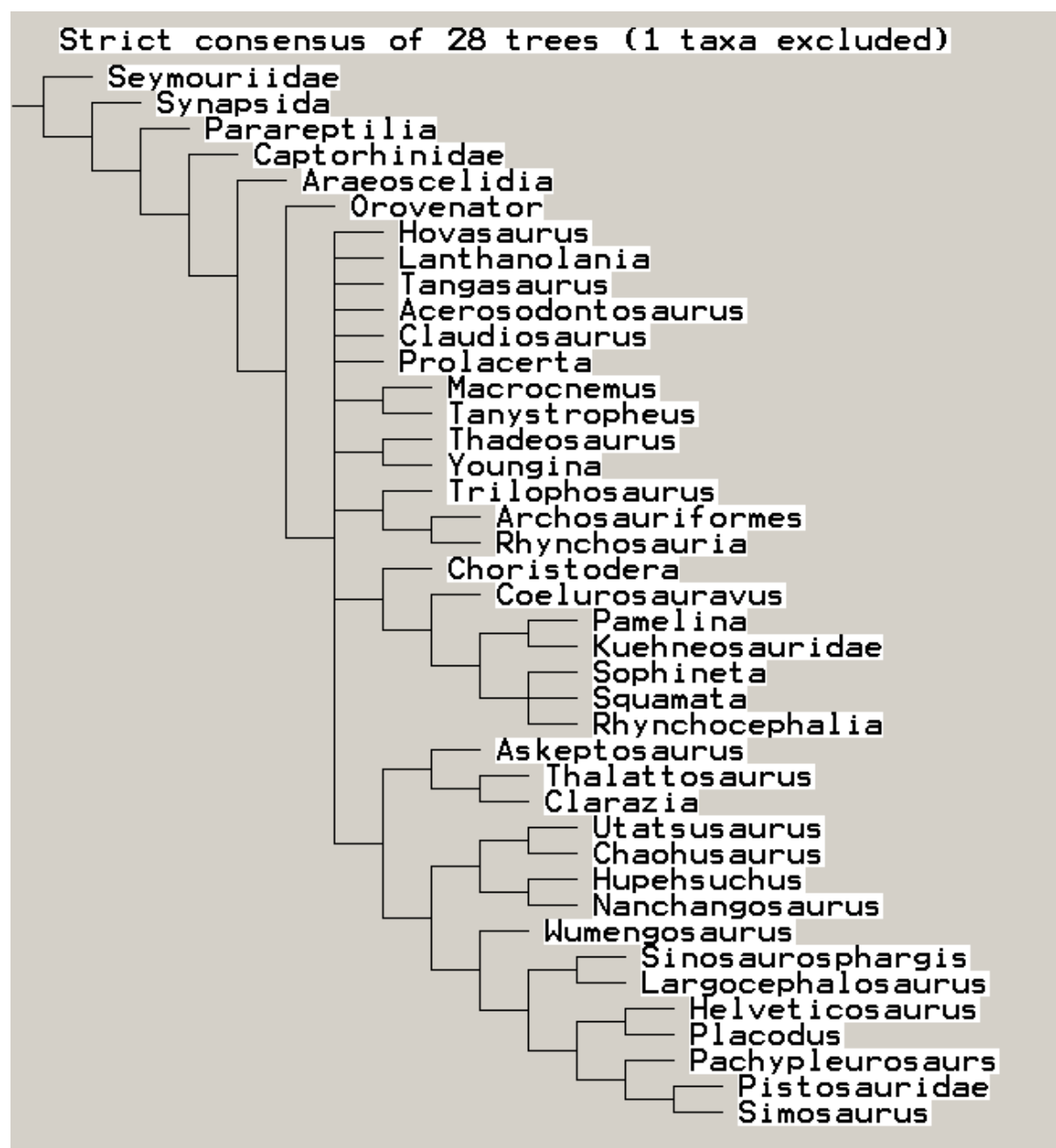
Analysis using the second matrix<sup>2</sup> with *Eusaurosphargis dalsassoi* added, but characters 50, 62, 63, 67, 71, 74, 114, 120, 151, and 171 excluded.

Supplementary Figure S8. Analysis 5 run in TNT.



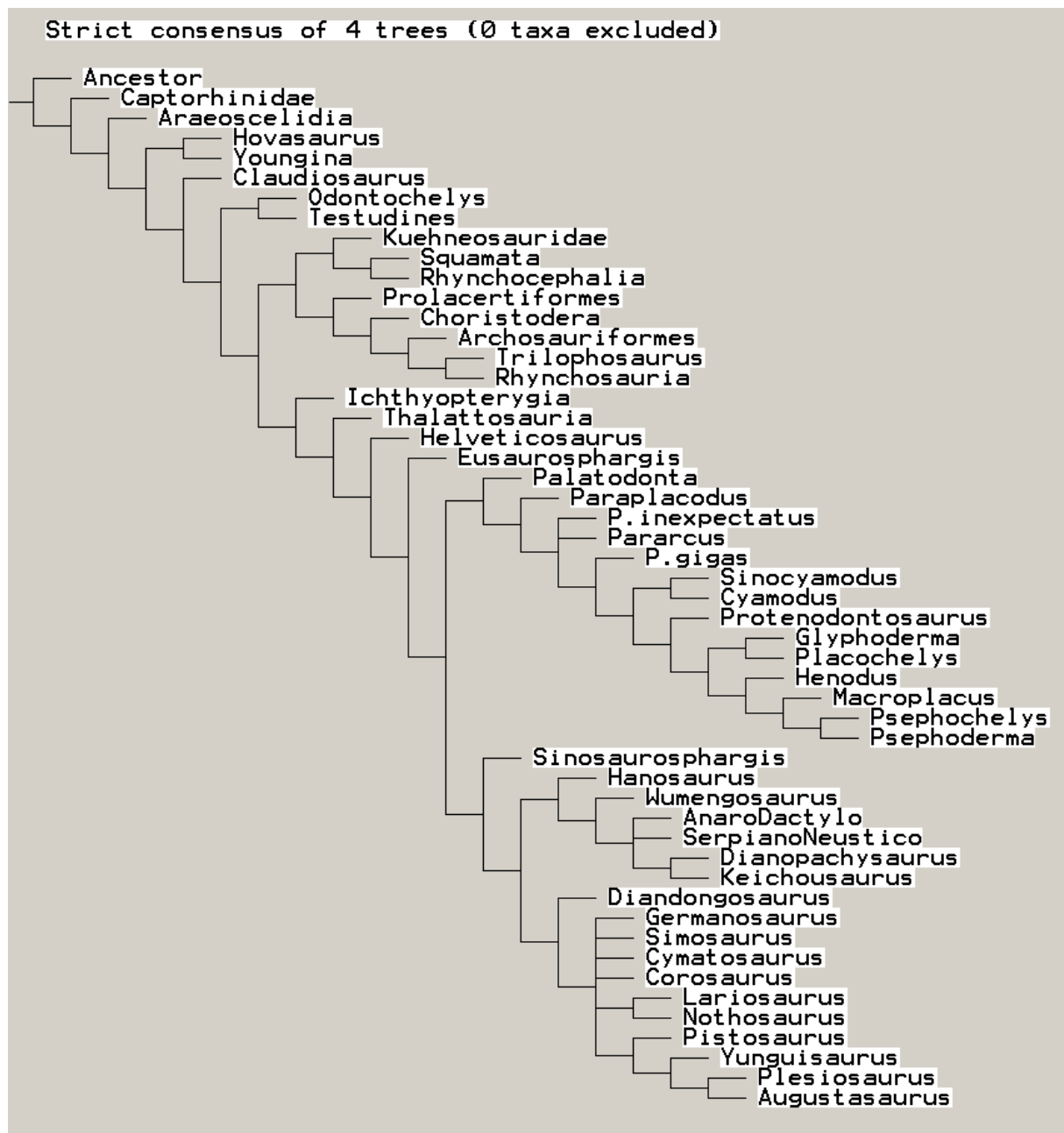
Analysis using the second matrix<sup>2</sup> with *Eusaurosphargis dalsassoi* added, but with characters 1, 9, 50, 58, 61, 62, 63, 67, 68, 71, 74, 114, 120, 145, 151, 171, 180, 186 excluded.

Supplementary Figure S9. Analysis 6 run in TNT.



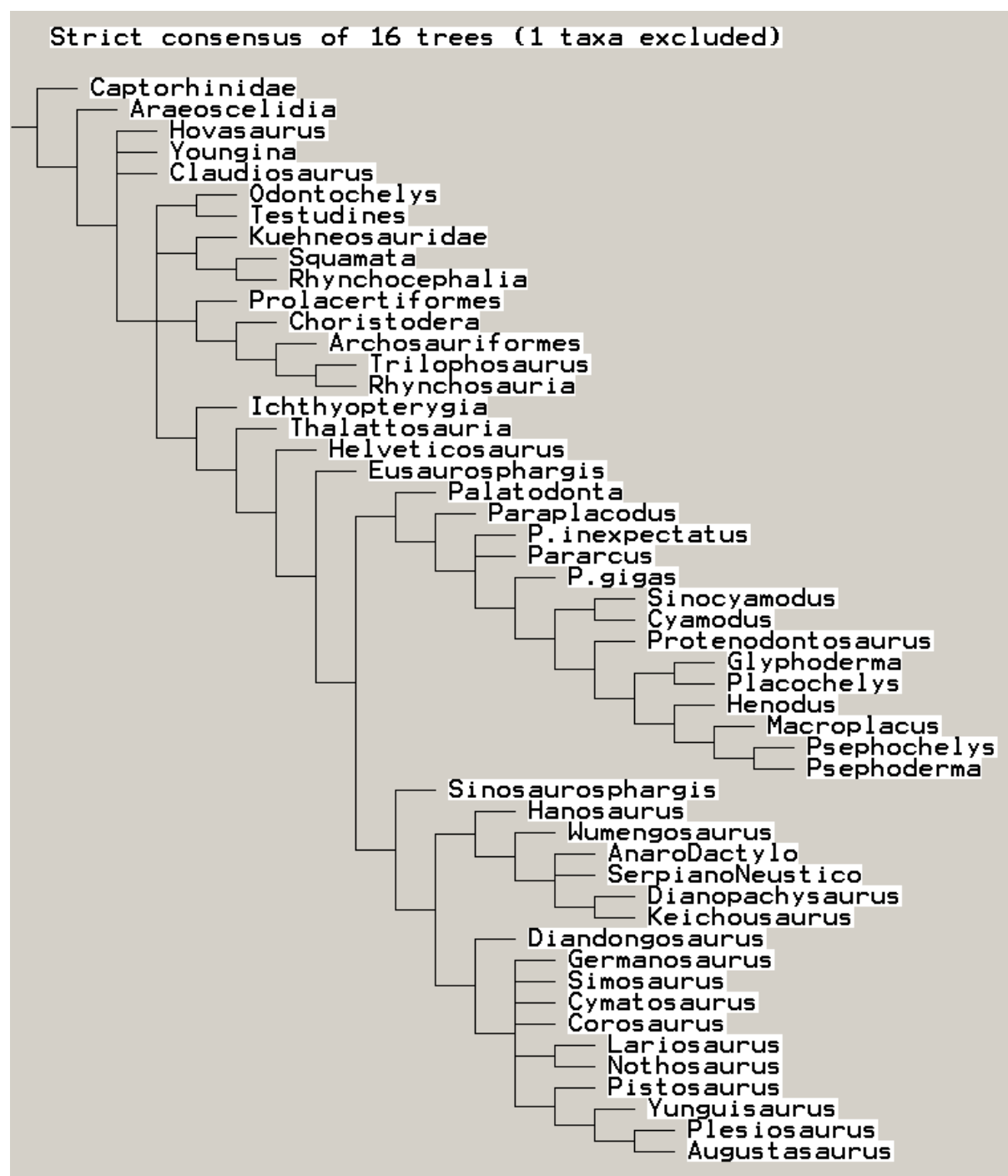
Analysis using the second matrix<sup>2</sup> with *Eusauropsphargis dalsassoi* removed and characters 1, 9, 50, 58, 61, 62, 63, 67, 68, 71, 74, 114, 120, 145, 151, 171, 180, 186 excluded.

Supplementary Figure S10. Analysis 7 run in TNT.



Analysis using the third matrix<sup>3</sup> with 'all-zero ancestor' as outgroup.

Supplementary Figure S11. Analysis 8 run in TNT.



Analysis using the third matrix<sup>3</sup> with 'all-zero ancestor' excluded and Captorhinidae as outgroup.



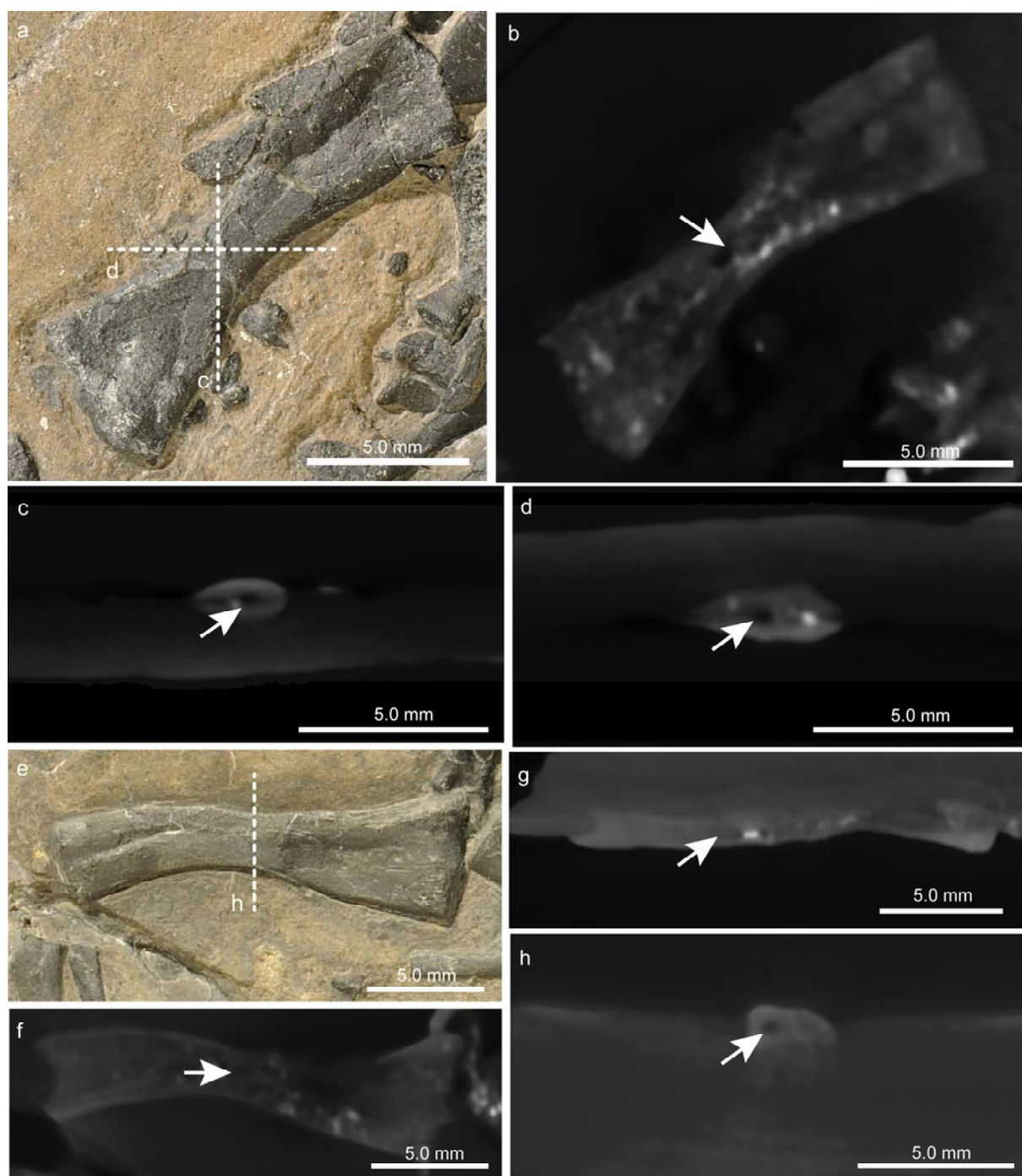
**Supplementary Figure S12. Selected postcranial bones of the holotype BES SC 390.**



Note that the bone identifications of the original species description<sup>4</sup> are given in parentheses. **(a)** humerus (humerus  $h_1$ ). **(b)** ischium (pubis  $p_2$ ); **(c)** ischium (pubis  $p_1$ ); **(d)** ilium (ilium); **(e)** ilium (unidentified bone); **(f)** pubis (ischium); **(g)** sacral rib 1 (caudal rib  $car_1$ ).



**Supplementary Figure S13. Microanatomy of stylopodial bones of PIMUZ A/III 4380.**



Photograph (a) and micro-CT images (b-d) of the right humerus, as well as photograph (e) and micro-CT images (f-h) of the right femur. Note that the position and planes of the cross-sectional slices in c, d, and h are marked by white stiped lines. Medullary cavities are marked by white arrows.

## Supplementary Note. Updated and new scorings for *Eusaurosphargis dalsassoi*.

Updated scoring of *Eusaurosphargis dalsassoi* used in Analysis 1 (and Analyses 2 and 3) in the first matrix<sup>1</sup> and in Analysis 7 (and Analysis 8) in the third matrix<sup>3</sup>:

110010???? ?????????? ?003???030 ??0??????? ?0?????1?? 0????1??0? ?000001011  
110?000?0? 10?1?10000 ?001110101 00?1001100 0??1?020?0 011?11211? ?10??001?1

New scoring of *Eusaurosphargis dalsassoi* used in Analysis 3 (and Analyses 4 to 6) in the second matrix<sup>2</sup>:

100????13? 010???????? ?????0????1 ??????1011 [01]10??1?100 1100001110 ??1?0?01?1  
211?0??00 ?00011???? ????????01 ?0?2010?00 0011?00?01 0000?????? 0?????????  
????11110? ?0????????? ??2??????11 0010?20??0 ?????111000 0?1?[12]1[01]?10 0????00000  
?00

## Supplementary References

- 1 Klein, N. & Scheyer, T. M. A new placodont sauropterygian from the Middle Triassic of the Netherlands. *Acta Palaeontol. Pol.* **59**, 887-902 (2014).
- 2 Chen, X.-h., Motani, R., Cheng, L., Jiang, D.-y. & Rieppel, O. The enigmatic marine reptile *Nanchangosaurus* from the Lower Triassic of Hubei, China and the phylogenetic affinities of Hupehsuchia. *PLOS ONE* **9**(7), e102361; 10.1371/journal.pone.0102361 (2014).
- 3 Neenan, J. M., Li, C., Rieppel, O. & Scheyer, T. M. The cranial anatomy of Chinese placodonts and the phylogeny of Placodontia (Diapsida: Sauropterygia). *Zool. J. Linn. Soc.* **175**, 415-428 (2015).
- 4 Nosotti, S. & Rieppel, O. *Eusaurosphargis dalsassoi* n. gen n. sp., a new, unusual diapsid reptile from the Middle Triassic of Besano (Lombardy, N Italy). *Mem. Soc. ital. sci. nat. Mus. civ. stor. nat. Milano* **31**, 3-33 (2003).